VAISALA

USER'S GUIDE

Vaisala Dewpoint and Pressure Transmitter DPT146 for Compressed Air

M211372EN-D

PUBLISHED BY

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CHAPTER 1

GENERAL INFORMATION

This chapter provides general notes for the manual and the DPT146.

About This Manual

This manual provides information for installing, operating, and maintaining Vaisala Dewpoint and Pressure Transmitter DPT146 for Compressed Air.

Contents of This Manual

This manual consists of the following chapters:

- Chapter 1, General Information, provides general notes for the manual and the DPT146.
- Chapter 2, Product Overview, This chapter introduces the features, advantages, and product options.
- Chapter 3, Functional Description, describes the functionality of the DPT146.
- Chapter 4, Installation, provides you with information that is intended to help you install the DPT146.
- Chapter 5, Operation, contains information that is needed to operate the DPT146.
- Chapter 6, Maintenance, provides information that is needed in basic maintenance of the DPT146.
- Chapter 7, Troubleshooting, describes common problems, their probable causes and remedies, and provides contact information for technical support.
- Chapter 8, Technical Data, provides the technical data of the DPT146.

Version Information

Table 1 Manual Revisions

Manual Code	Description
M211372EN-D	This manual. Added a minimum baud rate requirement when using the Modbus protocol. Added a packing recommendation for return shipment.
M211372EN-C	Previous version.

Related Manuals

Table 2 Related Manuals

Manual Code	Manual Name
M211370EN	DPT146 Quick Guide

Documentation Conventions

Throughout the manual, important safety considerations are highlighted as follows:

WARNING	Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION	Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE	Note highlights important information on using the product.

Safety

The DTP146 delivered to you has been tested for safety and approved as shipped from the factory. Note the following precautions:

WARNING	Ground the product and verify outdoor installation grounding periodically to minimize shock hazard.

CAUTION	Do not modify the unit. Improper modification can damage the product or lead to malfunction.

ESD Protection

Electrostatic Discharge (ESD) can cause immediate or latent damage to electronic circuits. Vaisala products are adequately protected against ESD for their intended use. It is possible to damage the product, however, by delivering electrostatic discharges when touching, removing, or inserting any objects inside the equipment housing.

To make sure you are not delivering high static voltages yourself:

- Handle ESD sensitive components on a properly grounded and protected ESD workbench.
- When an ESD workbench is not available, ground yourself to the equipment chassis with a wrist strap and a resistive connection cord.
- If you are unable to take either of the above precautions, touch a conductive part of the equipment chassis with your other hand before touching ESD sensitive components.
- Always hold component boards by the edges and avoid touching the component contacts.

Recycling

Recycle all applicable material.

Dispose of the unit according to statutory regulations. Do not dispose of with regular household refuse.

Regulatory Compliances

The Vaisala Dewpoint and Pressure Transmitter DPT146 for Compressed Air is in conformity with the provisions of the following EU directive(s):

- EMC Directive

Conformity is shown by compliance with the following standards:

- EN 61326-1: Electrical equipment for measurement, control, and laboratory use – EMC requirements – for use in industrial locations.
- EN 550022: Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.

CE

Patent Notice

The Vaisala Dewpoint and Pressure Transmitter DPT146 for Compressed Air is protected by, for example, the following patents and their corresponding national rights:

Finnish patent 98861, French patent 6650303, German patent 69418174, Japanese patent 3585973, UK patent 0665303, and U.S. patent 5607564.

Trademarks

BAROCAP® and DRYCAP® are registered trademarks of Vaisala Oyj.

Windows® is a registered trademark of Microsoft Corporation in the United States and/or other countries.

Software License

This product contains software developed by Vaisala. Use of the software is governed by license terms and conditions included in the applicable supply contract or, in the absence of separate license terms and conditions, by the General License Conditions of Vaisala Group.

Warranty

Visit our Internet pages for standard warranty terms and conditions: www.vaisala.com/warranty.

Please observe that any such warranty may not be valid in case of damage due to normal wear and tear, exceptional operating conditions, negligent handling or installation, or unauthorized modifications. Please see the applicable supply contract or Conditions of Sale for details of the warranty for each product.

CHAPTER 2

PRODUCT OVERVIEW

This chapter introduces the features, advantages, and product options.

Introduction to DPT146

Vaisala Dewpoint and Pressure Transmitter DPT146 for Compressed Air combines online measurement of dewpoint and pressure. The dewpoint measurement is continuously pressure compensated using the measured pressure. Temperature output is also available if the transmitter has been ordered with serial line output.

DPT146 also calculates two other parameters, ppm moisture by volume and dewpoint in atmospheric pressure. The transmitter's compact size makes it well suited for integration into OEM systems.

Table 3 Output Parameters of DPT146

Parameter	Abbreviation	Metric Unit	Non-Metric Unit
Dewpoint/frost point temperature*	Tdf	ºC	ºF
Dewpoint/frost point temperature*, converted to atmospheric pressure	Tdfatm	ºC	ºF
ppm moisture, by volume	H20	ppm	ppm
Pressure, absolute	P	bara	psia
Temperature**	T	ºC	ºF

* When the dewpoint is below 0 °C, the transmitter outputs frost point for T_d
** Available if RS-485 only output is selected

Basic Features and Options

- Utilizes the Vaisala MPS1 multiparameter sensor with Vaisala's BAROCAP® and DRYCAP® technologies.
- Measurement ranges of measured parameters:
  - Dewpoint -60 ... +30 °C (-76 ... +86 °F) T_d
  - Pressure, absolute 1 ... 12 bar (14.5 ... 174 psi)
  - Temperature -40 ... +80 °C (-40 ... +176 °F)
- Two analog output channels, selectable from 0 … 20 mA / 4 ... 20 mA and 0 … 5 V / 0 … 10 V.
- Digital output: non-isolated RS-485.

- Easy verification of dewpoint measurement with the Vaisala DRYCAP® Hand-Held Dewpoint Meter DM70.
- Optional accessories:
  - USB service cable for configuration and calibration.
  - Loop-powered display.
  - Various sampling cells with different installation options.

1109-029

Figure 1 DPT146 with ISO G1/2” Thread

Transmitter Structure

The structure of the DPT146 is shown in Figure 2 below. The transmitter body does not have user serviceable parts inside, and is not designed to be opened. Opening the transmitter will void the warranty.

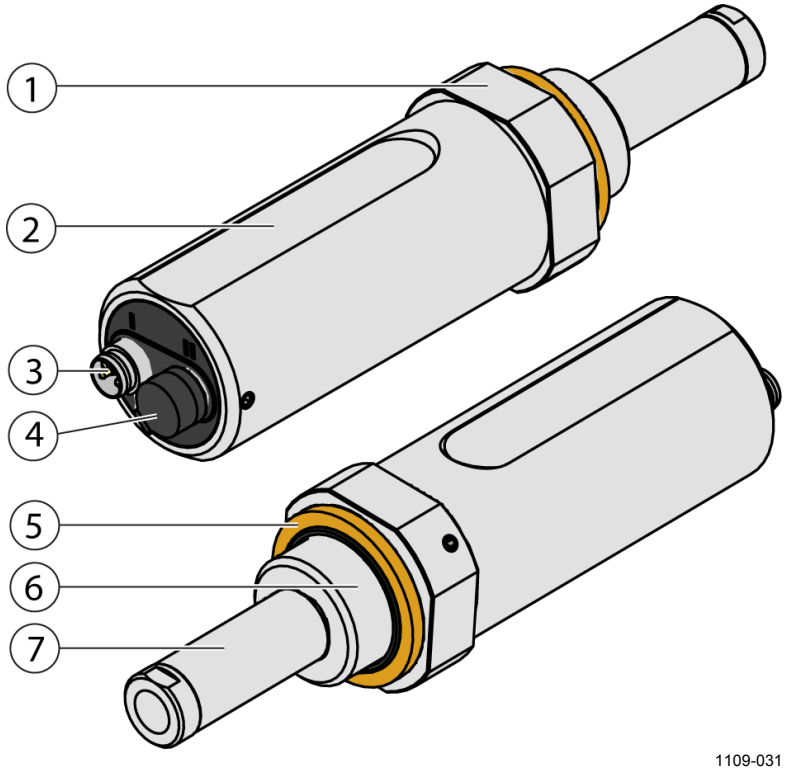

Figure 2 DPT146 Transmitter Structure

where

1 = 30 mm nut
2 = Transmitter body
3 = 4-pin M8 connector I: analog outputs and operating power
4 = 4-pin M8 connector II (shown with protective cap): Non-isolated RS-485 and operating power
5 = Sealing ring (included with transmitters that have ISO or UNF connection thread)
6 = Connection thread
7 = Stainless steel mesh filter that protects the MPS1 sensor

When the transmitter is delivered, the filter is protected by a yellow transport protection cap that keeps the sensor dry. The transport protection cap should be left on the transmitter during storage. Remove the transport protection cap before installing the transmitter.

Connection Cables

Vaisala supplies shielded cables with M8 female straight threaded connector. Available in four lengths:

- 0.3 m (1.0 ft)
- 3 m (9.8 ft)
- 5 m (16.4 ft)
- 10 m (32.8 ft)

Also available are cables for service port and field check use:

- USB service cable
- MI70 connection cable

For the order codes of the cables, refer to section Spare Parts and Accessories on page 64.

0910-135

Figure 3 Cable with Threaded Connector

0809-002

Figure 4 USB Service Cable

Loop-Powered Display (Optional)

DPT146 with 4 ... 20 mA current output can be connected to a loop-powered external LED display (type Nokeval 301, Vaisala order code 226476). The display provides a reading of one output parameter. The display is powered by the current signal, so there is no need for an external power supply.

The display is delivered at its default settings. Configure the display functions and scaling according to the documentation delivered with the display.

Figure 5 Nokeval 301 Loop-Powered Display

NOTE	The loop resistance of the display must be included in the loop resistance calculation for the complete current loop. For the loop resistance of the display, refer to the manufacturer’s documentation.

Sampling Accessories (Optional)

DPT146 is compatible with various sampling accessories. For more information on performing sampling, and a description of the accessories, see section Sampling from a Process on page 25.

For the order codes of the sampling accessories, refer to section Spare Parts and Accessories on page 64.

CHAPTER 3

FUNCTIONAL DESCRIPTION

This chapter describes the functionality of the DPT146.

Sensor Technology

MPS1 Multiparameter Sensor

DPT146 combines Vaisala's proven DRYCAP® sensor technology for industrial dewpoint measurement with BAROCAP® pressure sensor technology. Both technologies are integrated on the same MPS1 multiparameter sensor element, allowing for a highly compact and versatile transmitter.

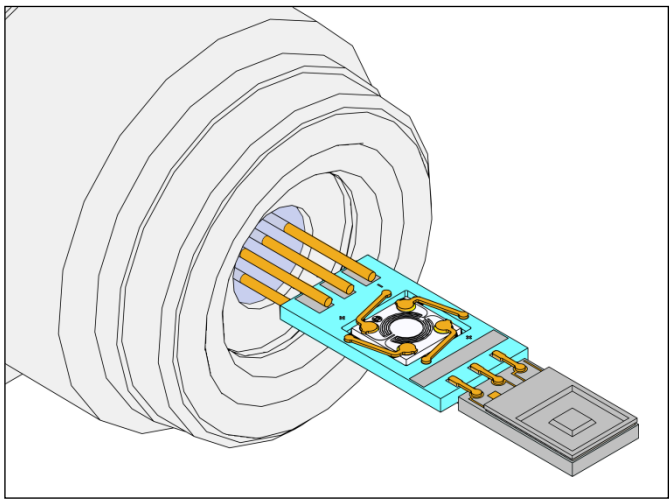

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Figure 6 MPS1 Sensor

There are several important advantages in using a transmitter with an integrated sensor:

- Reduces installation work and cost.
- Improves the leak tightness of the system as connection points are minimized.
- Enables online monitoring of all supported parameters.

DRYCAP® Technology

Vaisala DRYCAP® dewpoint measurement technology ensures accurate measurement with excellent long term stability. This results in very low maintenance requirements for the transmitter. The lasting performance is achieved with microprocessor technology and software that automatically performs self-diagnostic functions in addition to the normal dewpoint measurement. The self-diagnostic procedures that are conducted are called auto-calibration, sensor purge, and sensor warming.

Auto-Calibration

The auto-calibration feature of the MPS1 multiparameter sensor is an automatic procedure which greatly reduces the possible drift in the dry end of the dewpoint measurement. It is performed at one hour intervals, and when the power is switched on. During auto-calibration the sensor is warmed for a short period (< 1 min) and the sensor capacitance values are evaluated at the elevated temperature. The possible dry end drift is then corrected to correspond to the calibrated values. During the auto-calibration the transmitter outputs the dewpoint value prior to the procedure.

Auto-calibration is carried out only if several criteria for the measurement environment are fulfilled. This ensures the reliability of the adjustments, and maintains the excellent long term stability. These criteria include, for example, a stable enough moisture level in the measured atmosphere. If the conditions are not fulfilled, the auto-calibration function is postponed until satisfactory conditions are reached.

Sensor Purge

Sensor purge is also an automatic procedure that minimizes the drift at the wet end readings of the dewpoint measurement. Sensor purge is performed once a day, and five minutes after the power is switched on. The sensor is heated for several minutes which will then evaporate all excess molecules out of the sensor polymer. This, together with the auto-calibration, results in a very small drift of the sensor due to the very linear behavior of the polymer technology.

Sensor Warming in High Humidities

DPT146 transmitter has a warming feature which prevents the sensor and filter from becoming wet in high humidities. High humidity may be present when the dewpoint temperature rises close to the gas temperature.

Sensor warming is switched on automatically when the humidity in the measured gas increases to a level where dew can start to form. The

advantage of sensor warming is the rapid response of dewpoint measurement. A wet sensor and filter would otherwise result in a dewpoint equal to ambient temperature (that is RH = 100 %).

If in spite of sensor warming the sensor gets soaked, it will recover fully back to normal operation after it dries out.

NOTE	Sensor warming is not available if the transmitter has been ordered with RS-485 only output.

BAROCAP® Technology

The BAROCAP® silicon capacitive absolute pressure sensor was developed by Vaisala for barometric pressure measurement applications. The BAROCAP® sensor has excellent hysteresis and repeatability characteristics, low temperature dependence, and a very good long-term stability. The ruggedness of the BAROCAP® sensor is outstanding and the sensor is resistant to mechanical and thermal shocks. The pressure measurement of the MPS1 multiparameter sensor is based on an advanced RC oscillator and reference capacitors against which the capacitive pressure sensor is continuously measured. The microprocessor of the transmitter performs compensation for pressure linearity and temperature dependence.

DPT146 Startup Sequence

When the transmitter is powered up, it will perform the sequence shown in Figure 7 below. After a five-second startup, the transmitter will measure normally for five minutes, after which it will perform the sensor purge and auto-calibration functions. This can take up to six minutes, during which time the output is frozen: it will display the last measured values before the sensor purge began.

Normal operation and output is typically achieved no later than 11 minutes after startup. The sensor purge will repeat every 24 hours, and auto-calibration every hour. The output will again be frozen for their duration.

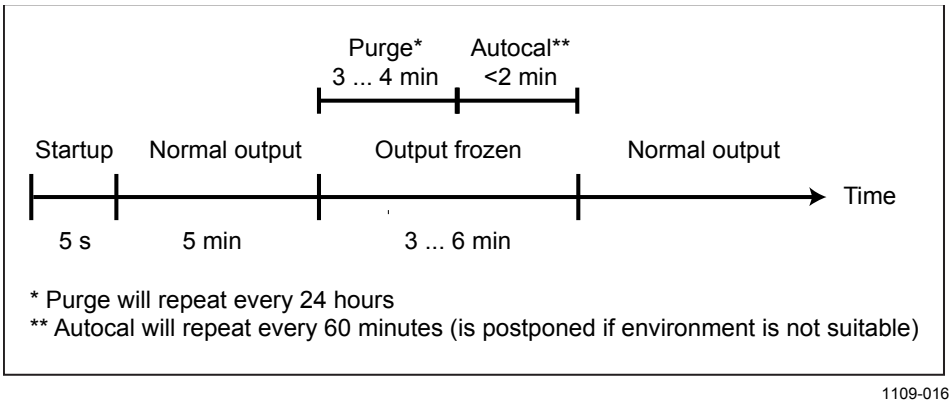


Figure 7 DPT146 Startup Sequence

NOTE The transmitter always performs this sequence when starting up. Keep the transmitter continuously powered to optimize its measurement performance and availability.

CHAPTER 4
INSTALLATION

This chapter provides you with information that is intended to help you install the DPT146.

Transmitter Configuration Before Installation

You may wish to configure your transmitter before physically installing it. For easy access to the serial line, use the USB service cable and a terminal program on a PC. Instructions for using the serial line and the serial commands are provided in Chapter 5, Operation, on page 32.

Examples of configurable settings for analog outputs:

1. Analog output mode, output parameters, and scaling.
2. Analog output error level.

Examples of configurable settings for RS-485 output:

1. By default, DPT146 transmitters are configured for single transmitter operation. Serial operation mode is **STOP** and address is **0**.

   To configure transmitters for operation on a common line, you must give each transmitter a unique address (range 0 ... 255) and set their serial operation mode to POLL.
2. The default serial line settings may not be right for your RS-485 line.
3. You may need to change the transmitter's serial output format to suit your needs.

Selecting the Location

It is important that the conditions at the point of installation represent well the gas to be measured. All leaks in the system must be eliminated to avoid ambient humidity affecting the measurement.

Direct installation to the measured gas is the recommended installation method if the temperature of the gas is suitable for DPT146 and no additional filtering is needed due to very dusty or oily gas. Pressure at the

measurement point should be within 1 ... 10 bar (14.5 ... 145 psi). The maximum pressure tolerance of the transmitter is 50 bar (725 psi).

If the gas temperature is higher than the specified maximum operating temperature of the transmitter, gas sampling and cooling it to ambient temperature (for example, 20 °C / 68 °F) is recommended. Note that the dewpoint temperature must be clearly lower than the ambient temperature to avoid condensation in the sampling line. Sampling from the process is easy by using Vaisala sampling cell options; see section Sampling Accessories on page 25.

DPT146 is light in weight, which means that it can be installed in a sample pipeline in the sampling cells without the need of any additional mechanical support.

Installing the Transmitter

After selecting a suitable measurement location, follow the procedure below to install the transmitter:

1. Remove the yellow transport protection cap from the transmitter.

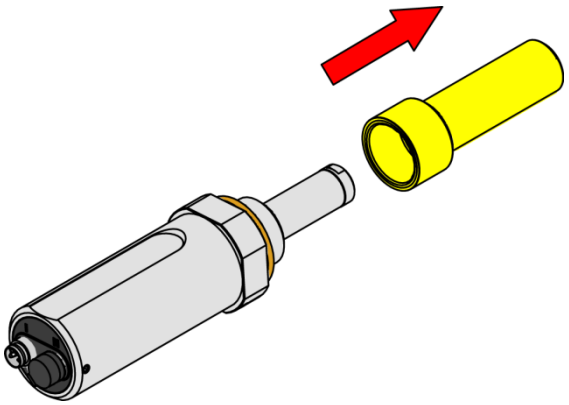


Figure 8 Removing the Transport Protection Cap

2. Make sure that the threads on the mounting point are of the correct type, and fasten the transmitter to the measurement point. When installing a transmitter with ISO or UNF thread, use the provided sealing ring to achieve a tight installation. Check that the sealing ring remains centered.

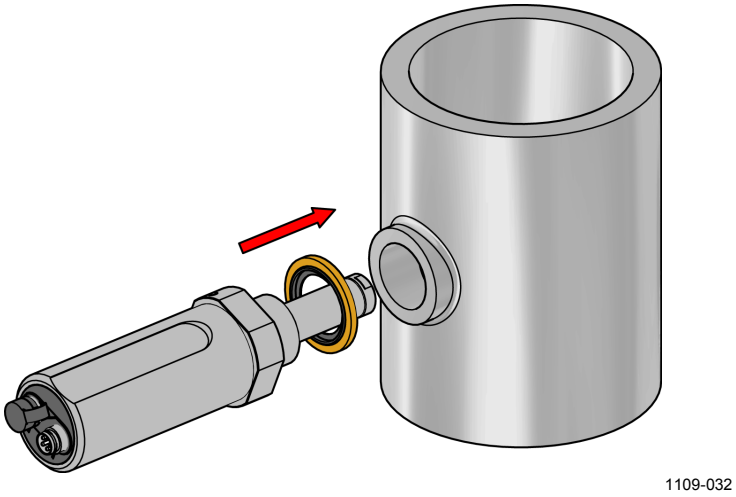


Figure 9 Installing the Transmitter

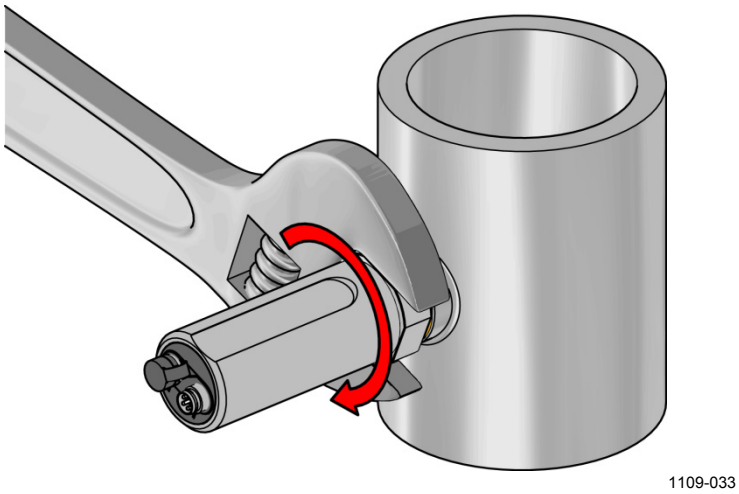


Figure 10 Tightening with a Wrench

3. Tighten the connection by turning with a wrench (max. 50 Nm).

CAUTION	Only tighten the transmitter from the 30 mm nut. Do NOT apply force to other points in the transmitter body.

4. Continue with the wiring of the transmitter. See section Wiring on page 24.

Wiring

CAUTION The power supply lines are internally connected. You can use either one of them, but do not connect more than one supply voltage in permanent installations. Temporary simultaneous use with the USB service cable or DM70 handheld dewpoint meter (which also provide power) is OK.

Table 4 Connector Pinouts

Pin	Connector I	Connector II	Wire color
1	VDC supply+	VDC supply+	Brown
2	Ch1+	RS-485 D0-	White
3	GND	GND	Blue
4	Ch2+	RS-485 D1+	Black

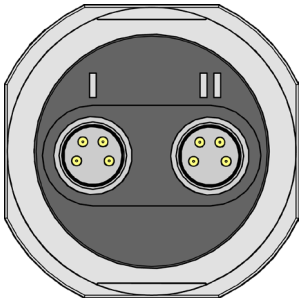


Figure 11 Connectors I and II

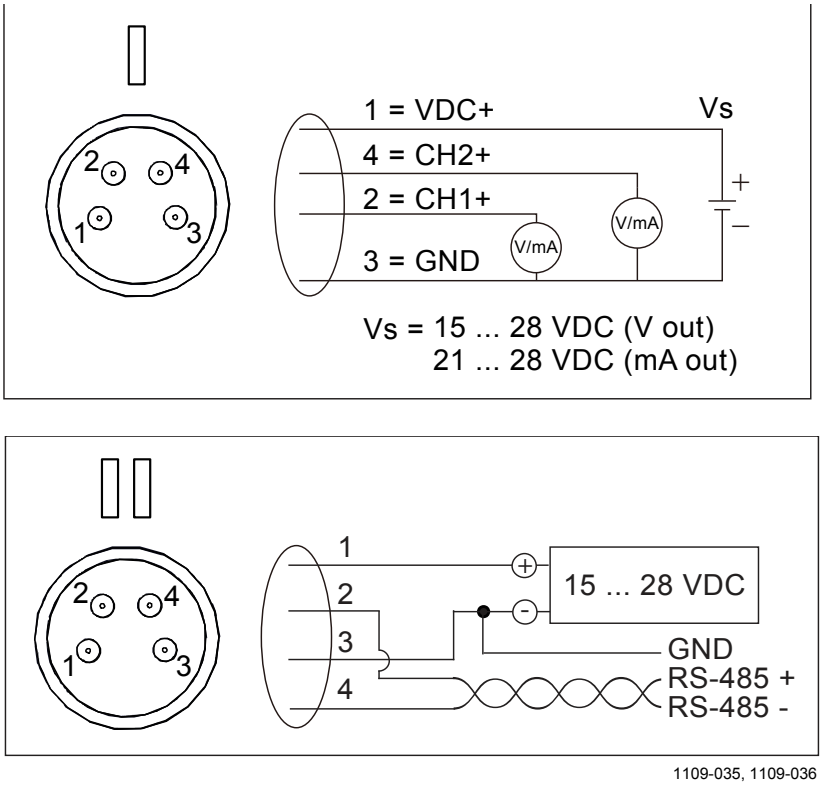


Figure 12 Connector Pinout

Sampling from a Process

Sampling is needed when direct measurement of the air or gas is not possible or desirable. This may be related to, for example, a high process temperature, protecting the sensor from water spikes, the need to easily detach the instrument from a pressurized process without running the whole process down, or wanting to make the measurement at a more convenient location.

Make sure there is sufficient flow of gas to the sensor (for example, 1 l/min) to give a representative sample.

You can use the Vaisala Humidity Calculator to simulate the effect of pressure change to dewpoint. The Humidity Calculator can be found at: www.vaisala.com/humiditycalculator.

Sampling Accessories

DMT242SC Sampling Cell

DMT242SC is a basic sampling cell with only the main sampling cell body. The inlet and outlet are female threaded sample connectors (inlet G3/8", outlet G1/4" ISO). Refer to Figure 13 on page 26.

DMT242SC is suitable for users requiring only a sampling cell to fit the transmitter into and doing further assembly (piping into inlet and outlet, valves, possible flow meter) by themselves.

DMT242SC2 Sampling Cell with Swagelok Connectors

DMT242SC2 is similar to DMT242SC, but connections are made easy. The sampling cell includes welded Swagelok connectors at both the inlet and outlet that fit directly to 1/4" tubing.

To fit 6 mm tubing to the connectors, an adapter such as Swagelok® Reducer SS-6M0-R-4 (not supplied by Vaisala) can be used.

DMT242SC2 is the suitable choice in, for example, plastics drying systems, where the measurement is made by tapping off the dryer system and bringing a small air stream to the sensor. The Swagelok connectors of DMT242SC2 easily connect to a cooling coil or tubing providing the essential function of cooling the dry air to ambient temperature before it reaches the sensor.

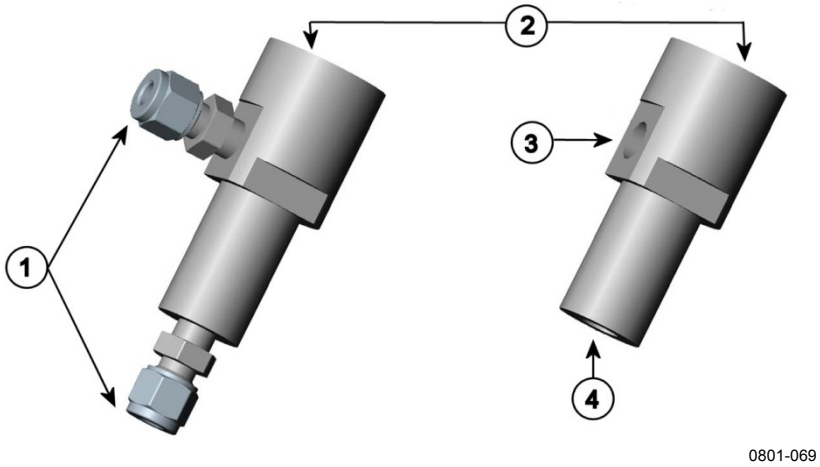


Figure 13 Sampling Cells DMT242SC2 (left) and DMT242SC (right)

where

1 = Male pipe welded connector Swagelok 1/4"
2 = G1/2"
3 = G1/4"
4 = G3/8"

DSC74 Sampling Cell with Quick Connector and Leak Screw

DSC74 has been designed especially for compressed air lines. The sampling cell contains an adjustable leak screw that allows keeping up the pipeline pressure at the sensor. The leak screw is opened and closed with a screwdriver. The leak screw should be half a turn open. This can be verified by first closing the leak screw, then turning 1/2 turn to open it. Then the air coming out will make a barely audible little hiss which can be lightly felt when putting a hand in front of the air stream.

NOTE	Do not open the leak screw more than 1/2 turn to avoid reducing the pressure in the sampling cell.

DSC74 comes with a quick connector that fits to industry standard compressed air line connectors (suitable for type D, Quick08, NIP08). This allows for easy installation and detachment of the dewpoint transmitter without having to shut down the process. Alternative ways to connect are through the two different thread adapters (G3/8" to G1/2" and G3/8" to G1/4" ISO) that are supplied with each DSC74 unit.

When using DSC74, seal the threads of the quick connector or thread adapter carefully with PTFE thread seal tape. Tighten with an open-end wrench.

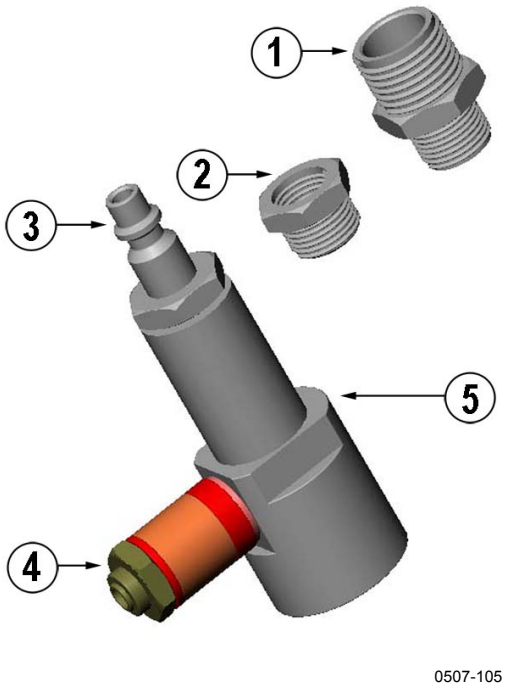


Figure 14 DSC74 Sampling Cell with Accessories

where

1 = Thread adapter type G3/8" - G1/2"
2 = Thread adapter type G3/8" - G1/4"
3 = Quick connector
4 = Leak screw
5 = Sampling cell body (DMT242SC)

DSC74B Two-Pressure Sampling Cell

DSC74B and DSC74C sampling cells are enhanced versions of the DSC74. The body is designed so that it is possible to measure at both system pressure and atmospheric pressure.

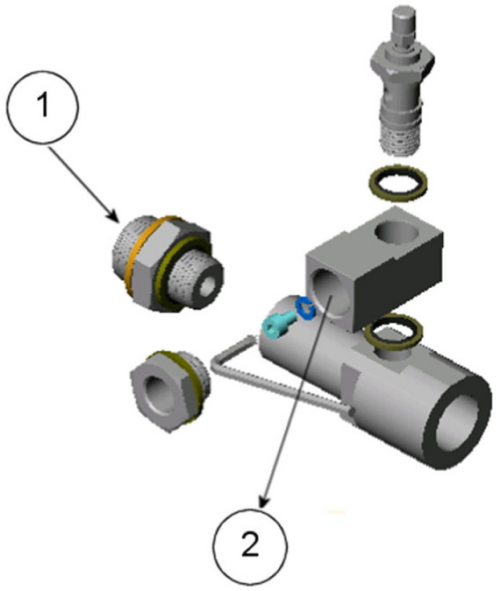
DSC74B limits the flow rate with a fixed leak screw. The flow is optimized for pressures 3 ... 10 barg. The fixed leak screw eliminates the risk of opening the leak screw fully by accident and this way emptying a gas vessel. The maximum flow can be increased, if needed, by removing the leak screw and adjusting the flow manually with the valve. Harmful gases can be recovered by connecting a collection system at the outlet (not available from Vaisala).

In the basic operation of the DSC74B, the gas flows to the sensor from the front and the outlet is on the side. To have the measurement done at

atmospheric pressure, the inlet and outlet are reversed. Then the reducing parts supplied (G3/8" - G1/2" or G3/8" - G1/4") on the outlet side help to protect the sensor from ambient humidity coming in.

DSC74B parts are:

- Sampling cell, thread 3/8"G
- Connection part with a needle valve and an integrated leak screw
- Reducing Nipple (thread adapter), G3/8" - G1/2"
- Reducing Adapter (thread adapter), G3/8" - G1/4"



0510-032

Figure 15 DSC74B

where

1 = Gas goes in
2 = Gas comes out

0510-033

Figure 16 Removing the Leak Screw

DSC74C Two-Pressure Sampling Cell with Coil

DSC74C with an outlet coil is designed for the most critical measurements at atmospheric pressure. In the DSC74C, the coil is connected to the sampling cell outlet to protect the sensor from ambient humidity disturbing the measurement. The coil can also be used as a cooling coil for sampling from high temperature processes.

DSC74C parts are:

- Sampling cell, thread G3/8"
- Connection part with a needle valve and an integrated leak screw
- Reducing Nipple (thread adapter), G3/8" - G1/2"
- Reducing Adapter (thread adapter), G3/8" - G1/4"
- Diffusion coil (for measurements in atmospheric pressure)

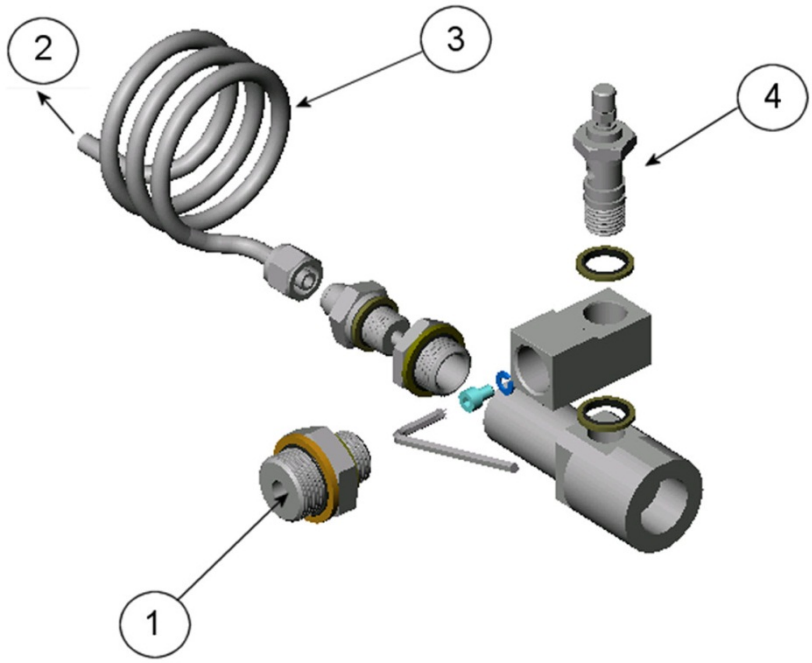


Figure 17 Default Assembly of DSC74C

where

1 = Gas goes in. The coil can also be used here.
2 = Gas comes out
3 = Coil
4 = Valve

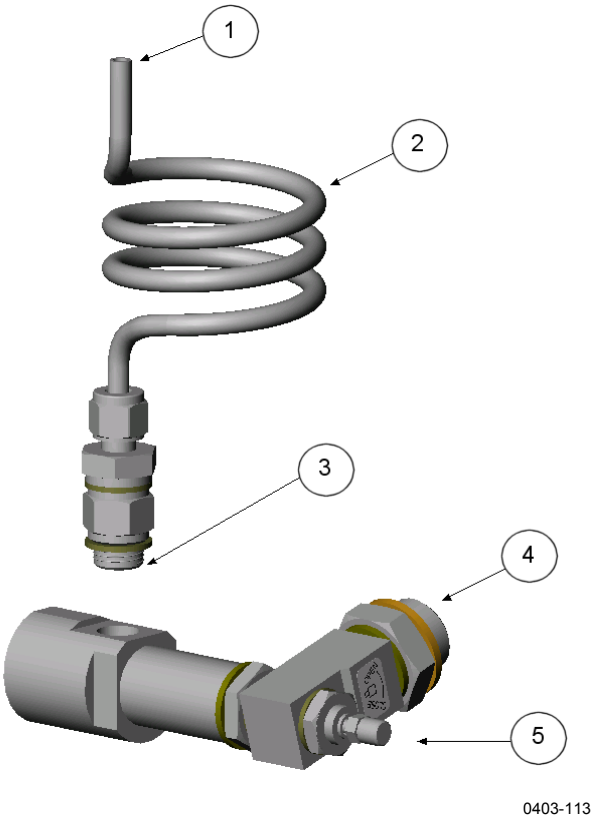


Figure 18 Alternative Assembly of DSC74C (for Tight Spaces)

where

1 = Gas comes out
2 = Coil
3 = Thread, max. size 7 mm
4 = Gas goes in
5 = Valve

The thread size cannot exceed 7 mm. Use the provided adapter to avoid damage to the transmitter.

DM240FA Duct Installation Flange

The transmitter can be installed directly in the measured gas through DM240FA duct installation flange. When the transmitter is installed directly on the process wall or pipe, note that a closing valve may be needed on both sides of the installed transmitter so that the transmitter can be removed from the process for calibration or maintenance.

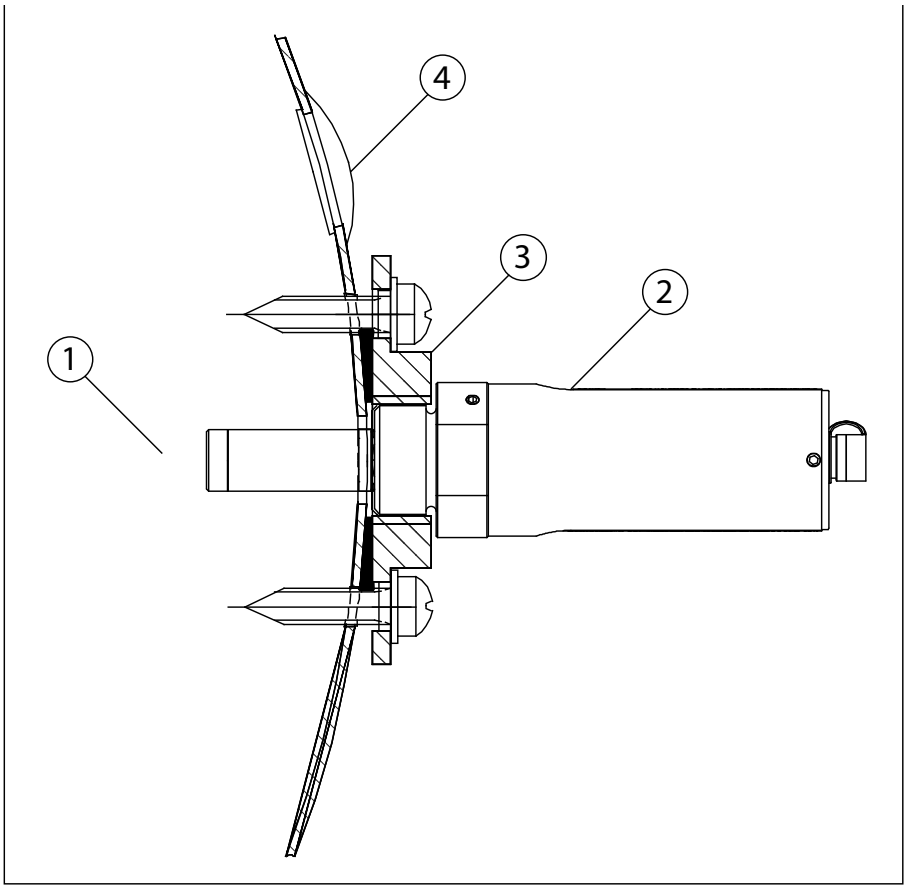


Figure 19 DM240FA with DPT146

where

1 = Measured gas
2 = DPT146 transmitter
3 = DM240FA flange (thread G1/2" ISO)
4 = Recommended additional hole (plugged) for dewpoint field check reference measurement probe (for example, Vaisala DMP74B)

CHAPTER 5

OPERATION

This chapter contains information that is needed to operate the DPT146.

Transmitter Start-Up

When the transmitter is connected to power supply, there is a delay of five seconds as the transmitter starts up. After the start-up is complete, the measurement data is available from the analog outputs or serial line.

For a description of how the diagnostic functions of the sensor affect the availability of live measurement at start-up, see section DPT146 Startup Sequence on page 20.

If serial line output is used, note that the transmitter will behave according to the configured serial mode:

- In STOP mode, the transmitter outputs the transmitter model and software version. This is the default mode.
- In RUN mode, a measurement output starts immediately.
- In POLL mode, the transmitter does not output anything after power-up.
- In MODBUS mode, the transmitter does not output anything after power-up.

For a description of the modes, see section Set Serial Line Operating Mode on page 47.

Serial Communication

Connecting to the Serial Interface

DPT146 can be connected to a PC using the RS-485 line on Port II. It is recommended that you use the USB service cable (Vaisala order code 219690) for the connection, since the cable also provides the operating power from the USB port.

If you have not used the USB service cable before, install the driver that came with the cable. Refer to section Installing the Driver for the USB Service Cable below for detailed instructions.

Installing the Driver for the USB Service Cable

Before taking the USB service cable into use, you must install the provided USB driver on your PC. When installing the driver, you must acknowledge any security prompts that may appear. The driver is compatible with Windows 2000, Windows XP, Windows Server 2003, and Windows Vista.

1. Check that the USB service cable is not connected. Disconnect the cable if you have already connected it.
2. Insert the media that came with the cable, or download the driver from www.vaisala.com.
3. Execute the USB driver installation program (setup.exe), and accept the installation defaults. The installation of the driver may take several minutes.
4. After the driver has been installed, connect the USB service cable to a USB port on your PC. Windows will detect the new device, and use the driver automatically.
5. The installation has reserved a COM port for the cable. Verify the port number, and the status of the cable, using the **Vaisala USB Instrument Finder** program that has been installed in the Windows Start menu.

Windows will recognize each individual cable as a different device, and reserve a new COM port. Remember to use the correct port in the settings of your terminal program.

There is no reason to uninstall the driver for normal use. However, if you wish to remove the driver files and all Vaisala USB cable devices, you can do so by uninstalling the entry for **Vaisala USB Instrument Driver** from the **Add or Remove Programs** (**Programs and Features** in Windows Vista, or later) in the Windows Control Panel.

Terminal Application Settings

The serial interface settings of the DPT146 RS-485 line are presented in Table 5 below.

Table 5 Default Serial Interface Settings

Property	Description / Value
Baud rate	19200
Parity	None
Data bits	8
Stop bits	1
Flow control	None

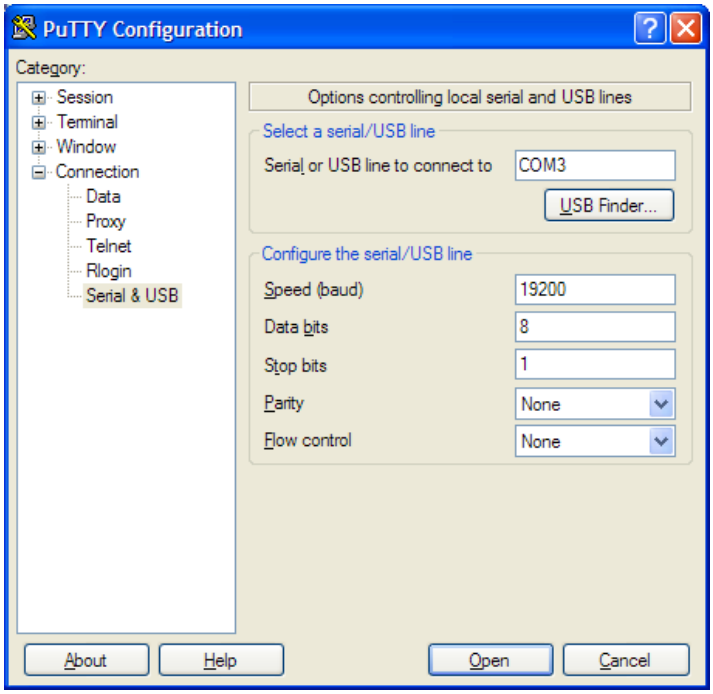
The steps below describe how to connect to the DPT146 using the PuTTY terminal application for Windows (available for download at www.vaisala.com) and a USB serial interface cable:

1. Connect the USB serial interface cable between your PC and the RS-485 port of the DPT146 (port II).
2. Start the PuTTY application.
3. Select the **Serial** settings category, and check that the correct COM port is selected in the **Serial line to connect to** field.

   Note: You can check which port the USB cable is using with the **Vaisala USB Instrument Finder program** that has been installed in the Windows Start menu.
4. Check that the other serial settings are correct for your connection, and change if necessary. **Flow control** should be set to **None** unless you have a reason to change it.
5. Click the **Open** button to open the connection window and start using the serial line.

   Note: If PuTTY is unable to open the serial port you selected, it will show you an error message instead. If this happens, restart PuTTY and check the settings.
6. You may need to adjust the **Local echo** setting in the **Terminal** category to see what you are typing on the serial line. To access the configuration screen while a session is running, click the right mouse button over the session window, and select **Change Settings...** from the pop-up menu.

If the DPT146 is in Modbus mode, to access the serial port command interface, follow the procedure in Accessing Serial Port Command Interface from Modbus Mode on page 51.



0807-004

Figure 20 PuTTY Terminal Application

List of Serial Commands

All commands can be issued either in uppercase or lowercase. In the command examples, the keyboard input by the user is in **bold** type.

The notation <cr> refers to pressing the carriage return (**Enter**) key on your computer keyboard. Enter a <cr> to clear the command buffer before starting to enter commands.

Table 6 List of Serial Commands

Command	Description
?	Show device information
??	Show device information (overrides poll mode)
ADDR [0 … 255]	Show or set transmitter address
AERR	Set analog output error level
AMODE	Set analog output mode
AOVER [ON/OFF]	Allow analog outputs to exceed their range 10%
ASEL	Set analog output parameters and scaling
ATEST	Test analog outputs
CLOSE	Close the temporary connection and return the device to POLL mode
ERRS	Display the currently active errors
FORM [modifier string]	Set output format
FRESTORE	Restore factory settings
HELP	Show list of currently available serial commands
INTV [0 ... 255 S/MIN/H]	Set the continuous output interval (for RUN mode and R command)
OPEN [0 … 255]	Open a line to transmitter at defined address
R	Start the continuous outputting
RESET	Reset the transmitter
S	Stop the continuous outputting
SDELAY [0 … 255]	Set response sending delay
SEND [0 … 255]	Output readings once (specify address for transmitters in POLL mode)
SERI [baud p d s]	Show or set the serial interface settings
SMODE [mode]	Show or set startup serial mode: RUN, STOP, POLL, or MODBUS
SNUM	Display transmitter serial number
TIME	Show transmitter uptime
UNIT [m/n]	Select metric or non-metric units
VERS	Show transmitter firmware version

Device Information

Show Device Information

The **?** command outputs a listing of device information.

?<cr>

Command **??** is a similar command that is designed to be used if the transmitter is in POLL mode but its address is unknown. The transmitter will respond to the **??** command even while in POLL mode. Do not use the **??** command if you have more than one transmitter on an RS-485 line.

Example:

```
?
DPT146 1.0.23
Serial number  : F4040027
Batch number   : F3420010
Module number  : F3410011
Sensor number  : F1610003
Cal. date      : 20110907
Cal. info      : Vaisala/HEL
Time           : 05:11:35
Serial mode    :     STOP
Baud P D S     :    19200 N 8 1
Output interval:        5 S
Serial delay   :       10
Address        :        0
Ch1 output     : 4 ... 20 mA
Ch2 output     : 0 ...  5 V
Ch1 error out  :    0.000 mA
Ch2 error out  :    1.000 V
Ch1 P    lo    :     0.00 bara
Ch1 P    hi    :    10.00 bara
Ch2 Tdf  lo    :   -60.00 'C
Ch2 Tdf  hi    :    40.00 'C
```

Show Currently Active Errors

Use the **ERRS** command to display the currently active transmitter error messages. Possible errors and their causes are listed in Table 12 on page 59.

ERRS<cr>

Example:

```
errs
No errors
```

Example (one active error, caused by physical damage to the sensor):

```
errs
T MEAS error
```

Show Command List

Use the **HELP** command to list serial commands:

HELP<cr>

Example:

```
help
ADDR
AERR
AMODE
AOVER
ASEL
ATEST
CLOSE
ERRS
FORM
FRESTORE
INTV
OPEN
R
RESET
SDELAY
SEND
SERI
SMODE
SNUM
TIME
UNIT
VERS
```

Show Firmware Version

VERS<cr>

Example:

```
vers
DPT146 1.0.23
```

Show Serial Number

SNUM<cr>

Example:

```
snum
Serial number  : F4040027
```

Configuring Analog Output

Set Analog Output Mode

Use the **AMODE** command to change the analog output mode:

AMODE [*c1 c2***]**<cr>

where

c1 = Channel 1 analog output mode. Available options are:
1 = 0 ... 20 mA
2 = 4 ... 20 mA
4 = 0 ... 5 V
5 = 0 ... 10 V

c2 = Channel 2 analog output mode. Available options are the same as for channel 1.

Example:

```
amode 2 5
Ch1 output      : 4 ... 20 mA
Ch2 output      : 0 ... 10 V
```

Set Analog Output Parameters and Scaling

Use the **ASEL** command to show or set the output parameters and the scalings of the analog output.

ASEL [*ch1*] [*ch2*]<cr>

where

ch1 = Parameter that is output on analog channel 1. Available parameters are TDF, TDFA, H2O, and P.
ch2 = Parameter that is output on analog channel 2. Available parameters the same as for channel 1.

Example (show current settings):

```
asel
Ch1 Tdf  lo    :   -60.00 'C ?
Ch1 Tdf  hi    :    40.00 'C ?
Ch2 P    lo    :     0.00 bara ?
Ch2 P    hi    :    10.00 bara ?
```

Example (change output parameters to TDFA and H2O and set scaling):

```
asel h20 ta
Ch1 Tdfa lo    :    00.00 'C ? -80
Ch1 Tdfa hi    :    00.00 'C ? 20
Ch2 H2O  lo    :     0.00 ppm ? 0
Ch2 H2O  hi    :     0.00 ppm ? 500
```

Set Analog Output Error Notification

If the transmitter is malfunctioning, the analog output is set to a specified level. This overrides the normal measurement output of the channel. The default level is 0 mA or 0V, according to the output type. You can set the level using the **AERR** command.

AERR [*ch1*] [*ch2*]<cr>

where

ch1 = Error level for analog channel 1.
ch2 = Error level for analog channel 2.

Example (show current settings):

```
aerr
Ch1 error out  :    0.000 mA ?
Ch2 error out  :    0.000 V  ?
```

Example (set channel 1 error level to 20 mA, channel 2 to 10 V):

```
aerr 20 10
Ch1 error out  :   20.000 mA
Ch2 error out  :   10.000 V
```

NOTE	The error output value is displayed only when there are minor electrical faults such as a sensor damage. When there is a severe device malfunction, the error output value is not necessarily shown.

Extend Analog Output Range

Use the **AOVER** command to allow the analog output channels to exceed their specified range by 10%. The scaling of the parameter remains as before; the extra range is used for additional measurement range in the high end of the scale.

AOVER [*ON/OFF*]<cr>

Example:

```
aover on
AOVER                :        ON
```

The following example illustrates how the analog output is affected. Channel 1 outputs T_d with voltage output 0 … 5 V (-80 … -30 °C). After giving the **AOVER ON** command, the range is 0 … 5.5 V (-80 … -25 °C). Note that the -30 °C T_d point is still at 5 V.

Test Analog Output

The operation of the analog outputs can be tested with the **ATEST** command by forcing the outputs to given values which can then be measured with a calibrated multimeter. After testing the outputs, give the **ATEST** command again to exit the test mode.

ATEST [*ch1*] [*ch2*]<cr>

where

ch1 = Analog output value for channel 1.
ch2 = Analog output value for channel 2.

The command output shows the test value of the analog output as well as diagnostic information that may be useful to Vaisala Service if there is a problem with the analog outputs.

Example (enabling analog output test mode, set level to 0 for both channels):

```
atest 0 0
   0.000       81
   0.000       79
```

Example (disabling analog output test mode, resuming normal output):

```
atest
```

Serial Line Output Commands

Start Measurement Output

Use the **R** command to start the continuous outputting of measurement values as an ASCII text string to the serial line. The format of the measurement message is set with the **FORM** command.

R<cr>

Example (measurement message in default format):

```
r
Tdf= 12.5 'C P=  0.990 bara T= 24.4 'C H2O= 15489 ppm
Tdfatm= 13.5 'C
Tdf= 12.5 'C P=  0.990 bara T= 24.4 'C H2O= 15488 ppm
Tdfatm= 13.5 'C
Tdf= 12.5 'C P=  0.990 bara T= 24.4 'C H2O= 15502 ppm
Tdfatm= 13.5 'C
...
```

Outputting the results continues in intervals issued with the command **INTV**. You can stop the output by pressing the **Esc** key, or with the command **S**. Since the interface is half-duplex, you must enter the commands when the transmitter is not outputting.

Stop Measurement Output

You can stop the measurement output by pressing **ESC**, or with the **S** command:

S<cr>

Set Output Interval

Use the **INTV** command to change the output interval of the automatically repeating measurement messages. The measurement messages are repeated in the RUN mode, or after the **R** command has been given.

INTV [*n xxx*]<cr>

where

n	=	time interval, range 0 ... 255
xxx	=	time unit = "S", "MIN", or "H"

The shortest output interval (with n = 0) outputs the measurement messages as quickly as the transmitter's internal measurement cycle produces them, without additional delay.

Example:

```
intv 1 min
Output interval:        1 MIN
```

Output a Reading Once

Use the **SEND** command to output a single measurement message. The output message is sent in the format that has been set using the **FORM** command.

SEND [*address*]<cr>

where

address = Address of the transmitter, range 0 ... 255.

Specifying the address is only necessary if the target transmitter is in POLL mode, and has not been accessed with the **OPEN** command.

Example:

```
send
Tdf= 12.5 'C P=  0.991 bara T= 24.4 'C H2O= 15504 ppm
Tdfatm= 13.5 'C
```

Configuring Measurement Parameters

Set Measurement Output Format

Use the serial line command **FORM** to change the measurement message sent by the transmitter. You can freely define the output message to include the desired parameters, formatting options, text strings, and additional fields.

FORM [*modifier string*]<cr>

where

modifier string = String of parameters and modifiers that defines the output format, length 1 ... 153 characters. Maximum length may be shorter when text strings are used. See Table 7 and Table 8 on page 46, and examples below.

You can return to the default format using the "**FORM** /" command.

Example of default output (continuous output from RUN mode):

```
Tdf= 12.5 'C P=  0.949 bara T= 24.4 'C H2O= 15506 ppm
Tdfatm= 13.5 'C
Tdf= 12.5 'C P=  0.949 bara T= 24.4 'C H2O= 15500 ppm
Tdfatm= 13.5 'C
...
```

Command to set output format as Tdf and P with Modulus-256 checksum:

```
form 3.1 "Tdf=" Tdf U3 3.3 "P=" P " " U4 " " CS2 \r \n
```

Output example:

```
Tdf= 12.5'C P=  0.949 bara 72
Tdf= 12.5'C P=  0.950 bara 6A
...
```

Command to set output format as Tdf and P, with **start of text** (ASCII character 002) and **end of text** (003) ASCII codes, and without line feed and carriage return at the end:

```
form #002 3.1 "Tdf=" Tdf U3 3.3 "P=" P " " U4 #003
```

Output example (ASCII codes not visible here):

```
Tdf= 11.6'C P=  0.952 baraTdf= 11.6'C P=  0.951 baraTdf=
11.6'C P=  0.951 baraTdf= 11.6'C P=  0.950 baraTdf= 12.5'C
...
```

Table 7 FORM Command Parameters

Measured Parameter	Abbreviation in FORM Command
Dewpoint/frost point temperature	Tdf
Dewpoint/frost point temperature, converted to atmospheric pressure	Tdfa
ppm moisture, by volume	H20
Pressure, absolute	P
Temperature	Ta

Table 8 FORM Command Modifiers

Modifier	Description
x.y	Length modifier (number of digits and decimal places)
#t	Tabulator
#r	Carriage-return
#n	Line feed
""	String constant, length 1 ... 15 characters
#xxx	ASCII code value (decimal) of a special character; for example, **#027** for ESC
ADDR	Transmitter address (0 ... 255)
ERR	Currently active transmitter errors in a four bit field: bit0bit1bit2bit3bit4 bit0 T MEAS error bit1 P out of range error bit2 Fmeas error bit3 Flash csum error
SN	Transmitter serial number
TIME	Time since transmitter was started or reset
Ux	Shows the name of the measurement unit using “x” number of characters. For example, **U3** shows the name of the measurement unit with three characters
CS2	Modulus-256 checksum of message sent so far, ASCII encoded hexadecimal notation
CS4	Modulus-65536 checksum of message sent so far, ASCII encoded hexadecimal notation
CSX	NMEA xor-checksum of message sent so far, ASCII encoded hexadecimal notation

Select Unit

Use the **UNIT** command to select metric or non-metric output units.

UNIT [*x*]<cr>

where

x = Selects the unit type to output:
m = metric units, for example, Celsius
n = nonmetric units, for example, Fahrenheit

Example:

```
unit m
Units           : Metric
```

Configuring Serial Line Operation

Set Serial Line Operating Mode

Use the **SMODE** command to set the start-up operating mode of the serial line.

SMODE [*mode*]<cr>

where

mode = STOP, RUN, POLL, or MODBUS.

Table 9 Selection of Output Modes

Mode	Measurement Output	Available Commands
STOP	Only with the **SEND** command.	All (default mode).
RUN	Automatic output.	Only command **S.**
POLL	Only with the **SEND** [*addr*] command.	**SEND** [*addr*] and **OPEN** [*addr*]. Other commands available after opening a line to the transmitter using the **OPEN** command. Use with RS-485 buses where multiple transmitters can share the same line.
MODBUS	Must be read from the transmitter using Modbus protocol.	Modbus protocol only; see Appendix A, Modbus Reference on page 66.

If the Modbus mode is activated, serial port commands cannot be used with the device. To access the serial port command interface, follow the procedure in Accessing Serial Port Command Interface from Modbus Mode on page 51.

Selected output mode will be activated at next reset or power up.

Example:

```
smode poll
Serial mode     :      POLL
```

Set Serial Line Settings

Use the **SERI** command to set the serial line settings. The new settings will be taken into use when the transmitter is reset or powered up.

Note that changing the serial line settings will slightly alter how the transmitter works with the MI70 indicator. If you are not using the default settings of 19200 N 8 1, you will have to power off the MI70 before it can find the transmitter (you will not be able to connect it on-the-fly).

When using the Modbus protocol, the baud rate must be 9600 or higher.

SERI [*b p d s*]<cr>

where

b = baud rate (300, 600, 1200, 2400, 4800, 9600, or 19200)
p = parity (n = none, e = even, o = odd)
d = data bits (7 or 8)
s = stop bits (1 or 2)

Example:

```
seri 9600 e 7 1
Baud P D S      :      9600 E 7 1
```

Set Transmitter Address

To operate in the POLL mode, the transmitter must have an address. If multiple transmitters share the same serial line, each transmitter must have a different address.

For a description of the serial interface modes, see section Set Serial Line Operating Mode on page 47.

ADDR [*address*]<cr>

where

address = Transmitter address, range 0 ... 255.

Example:

```
addr
Address         :         0      ?
```

Set Serial Line Response Time

With the **SDELAY** command you can set delay (response time) of the serial line, or view the currently set delay value. Increasing the value by one increases the delay by 4 milliseconds. For example, the default value is 10 which equals a ~40 ms answer delay.

SDELAY [*delay*]<cr>

where

delay = Serial line delay, range 0 … 255.

Example:

```
sdelay 20
Serial delay    :         20
```

Other Commands

Opening the Transmitter in POLL Mode

Use the **OPEN** command to connect to a transmitter that is in POLL mode.

OPEN [*address*]<cr>

where

address = Transmitter address, range 0 ... 255.

Example (target transmitter in POLL mode, with address 5):

```
open 5
DPT146   5 line opened for operator commands
```

Closing the Connection to a Transmitter in POLL Mode

The **CLOSE** command closes the connection to a transmitter.

CLOSE<cr>

Example:

```
close
line closed
```

Show Transmitter Uptime

Use the **TIME** command to show how long the transmitter has been operating since it was last reset or powered up.

TIME<cr>

Example:

```
time
Time            : 03:14:10
```

Reset Transmitter

Use the **RESET** command to reset the transmitter.

RESET<cr>

When the **RESET** command is given, the transmitter will restart as if it had just been powered on. All transmitter settings are retained. The serial line mode of the transmitter will be set to the mode that was set using the **SMODE** command.

Restore Factory Settings

Use the **FRESTORE** command to restore the factory settings to the transmitter. All user settings will be lost.

FRESTORE<cr>

Modbus Communication

Addressing with Modbus Protocol

The Modbus variant used in DPT146 communication is Modbus RTU. An example of Modbus addressing is shown below.

Request:	0x01	0x03	0x00	0x04	0x00	0x02	0x85	0xCA
	addr.	func.	reg. 5		2 registers		CRC check	

Response:	0x01	0x03	0x04	0xBC	0xC0	0x41	0xC2	0x6E	0x5E
	addr.	func.	len.	reg. 5		reg. 6		CRC check	

For a list of available Modbus registers, see Appendix A Modbus Reference on page 66.

Accessing Serial Port Command Interface from Modbus Mode

You cannot change configuration settings (other than Modbus address) while the device is in the Modbus mode. To use the configuration commands on a Modbus-enabled device:

1. Connect the USB service cable to the PC and install the driver, if necessary.
2. Open the terminal program and open a connection to the corresponding COM port using settings 19200, 8, N, 1, no flow control.
3. Plug the service cable to the connector II of the instrument.
4. In less than five seconds, send a hash character (#) and carriage return (Enter) to the device using the terminal program. The device is now ready for configuration commands. The Modbus mode is restored on next power-up unless Modbus is disabled with command **SMODE**.

For example, if you want to deactivate the Modbus mode on a DPT146 device, follow the procedure above and deactivate the Modbus mode with command **SMODE STOP**. On subsequent power-ups, the serial command interface will be activated.

Configuration Commands Related to Modbus

In addition to enabling the Modbus protocol in the device, Modbus over RS-485 needs the following software settings: serial bit rate, parity, number of stop bits, and Modbus device address.Use the service commands listed in Table 10 below to configure the Modbus RTU using the USB service cable.

Table 10 Configuration commands for Modbus RTU

Service Command	Description
SMODE MODBUS	Enable Modbus communication protocol See section Set Serial Line Operating Mode on page 47.
SERI b p 8 s	Change baud rate and parity b = baud rate (minimum 9600 when using Modbus) p = parity (E, N, or O) 8 = number of data bits must be 8 s = number of stop bits (2 if parity is N, 1 otherwise*) See section Set Serial Line Settings on page 48.
ADDR a	Set Modbus address a = new address (0…255)** See section Set Transmitter Address on page 48.
SDELAY d	Add extra Modbus response delay*** d = new delay in units of 1/250 seconds (0…255) See section Set Serial Line Response Time on page 49.

* Modbus specification defines that two stop bits must be used if parity is N.
** Setting address to zero switches the instrument offline from the Modbus bus. Addresses 248 … 255 are not supported by the Modbus standard but DPT146 works with them.
*** Extra response delay can be used, for example, to avoid problems caused by direction-switching delays in bus converters.

NOTE The instrument must be switched off and on before the configuration changes made with the service cable take effect.

CHAPTER 6

MAINTENANCE

This chapter provides information that is needed in basic maintenance of the DPT146.

Periodic Maintenance

Cleaning

The body of the transmitter can be cleaned by wiping with a moistened lint-free cloth. Do not immerse the transmitter in liquid, and do not use cleaning agents or solvents.

Changing the Filter

Replace the filter if it is contaminated. New filters and related accessories are available from Vaisala; see section Spare Parts and Accessories on page 64.

CAUTION	Be careful when changing the filter, since it is easy to break the sensor when the filter is removed.

CAUTION	If the transmitter is installed in a pressurized chamber, always make sure that the pressure of the chamber is equalized with the ambient pressure prior to removing the transmitter. When the transmitter is removed for maintenance, cap the hole with a capped nut. This way, the chamber can be pressurized although the transmitter is not in place. Plugs are available from Vaisala for ISO and NPT threaded connections.

When replacing the filter, handle the filter from the top of the filter body. Inspect the sealing ring for damage (used with ISO and UNF threads only), and replace it if necessary.

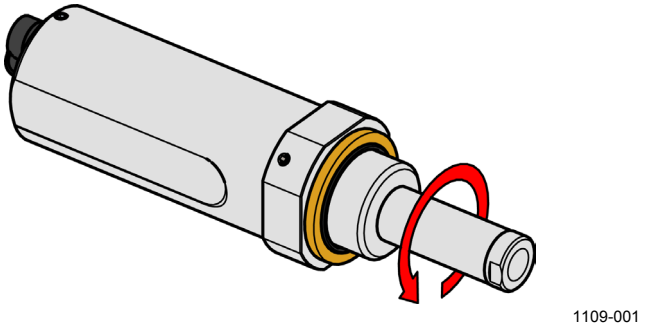


Figure 21 Opening the Filter

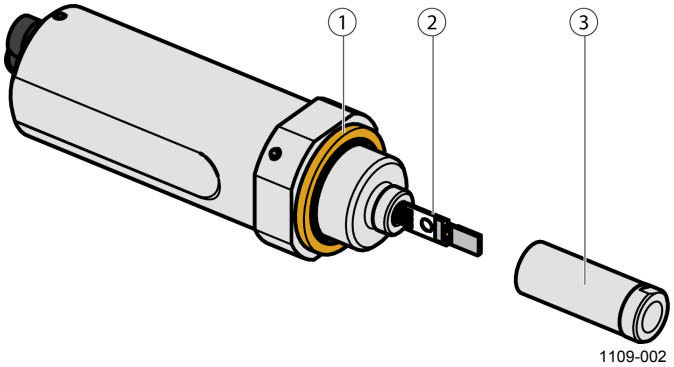


Figure 22 Filter Structure

where

1 = Sealing ring (use with UNF and ISO threads only)
2 = MPS1 multiparameter sensor
3 = Stainless steel mesh filter (turn from top of the filter)

Replace the filter as follows:

1. Grip the old filter from the top of the filter body using an 11 mm socket wrench. Turn the filter counterclockwise until it is loose.
2. Pull the filter straight out carefully - **do not damage the sensor**.
3. Take the new filter, and insert it to the filter thread.
4. Tighten the new filter by turning it clockwise with the 11 mm socket wrench. Tighten to 5 Nm.

Calibration and Adjustment

DPT146 is fully calibrated as shipped from factory. The recommended calibration interval is two years. If there is a reason to believe that the device is not within the accuracy specifications, you can perform a field check using the DM70 hand-held dewpoint meter, or an MI70 indicator with another DPT146.

If the field check indicates that the DPT146 is not within its accuracy specifications, contact a Vaisala Service Center or your local Vaisala representative to have the DPT146 adjusted.

Field Check Using an MI70 Indicator

Vaisala recommends the following equipment for field checking:

- A fully charged MI70 indicator (the measurement display that is included in the DM70 package)
- A calibrated reference probe that is suitable for the intended measurement environment and dewpoint range. The DMP74B probe is recommended for checking the dewpoint and temperature measurement accuracy. For checking all parameters, you can use another DPT146 transmitter as a reference.
- You also need a connection cable (Vaisala order code: 219980) to connect the DPT146 to the MI70 indicator. If you have two DPT146 transmitters, you need two cables.

NOTE In the procedure below, the readings of the transmitter and the reference probe are checked simultaneously. You can also check the reference probe and the DPT146 separately if they cannot be connected at the same time.

Perform the check as follows:

1. Place the reference probe and the DPT146 in the reference environment.
2. Connect the reference probe and the DPT146 to the MI70 indicator:
   - Reference probe to Port I
   - DPT146 to Port II
3. Turn on the MI70 indicator.
4. Check and adjust the environment settings if prompted. Refer to the DM70 User's Guide for the settings of the DMP74B probe.

5. Disable the **Auto power off** function of the MI70 indicator to prevent the indicator from powering off in the middle of the check. Check the setting in the **Settings - User Interface** menu, and change if necessary.

6. The MI70 can display three parameters at one time. To compare the readings of the DPT146 and the reference probe, select the desired parameter from the **Display – Quantities and Units** menu of the MI70. Select the same parameter from port I and II, and the delta parameter that shows the difference between the two. For example, $\Delta \mathbf{T_{d/f}}$ shows the difference in dewpoint between the two probes.

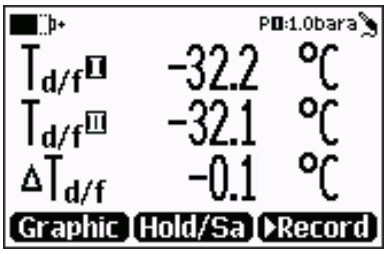


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Figure 23 Comparing Dewpoint Readings on MI70

7. After the measurement has stabilized, check the difference between the readings. It will give you an indication of the approximate drift of the DPT146 and its need for calibration. The difference between the readings should be no greater than the combined measurement uncertainty of the DPT146 and the reference probe.
8. Write down the results and repeat the comparison for each parameter you want to check.
9. If adjustment is required, contact a Vaisala Service Center or your local Vaisala representative to have the DPT146 adjusted.

NOTE

Some notes on using the MI70 indicator with the DPT146:

- If you disconnect the DPT146 while the MI70 indicator is on, the quantities measured will remain on the screen, but no measurement will be shown.
- Temperature measured by the DPT146 is shown as parameter **Ta** (not T) in the MI70.
- The messages from the transmitter will appear in English even if the MI70 has been set to another language.

Repair Maintenance

There are no user serviceable parts inside the transmitter. If there is a problem with your transmitter that you are unable to solve yourself or with the help of the Vaisala Helpdesk, contact a Vaisala Service Center to have the transmitter repaired.

For troubleshooting instructions and Vaisala contact information, see Chapter 7, Troubleshooting, on page 58.

CHAPTER 7

TROUBLESHOOTING

This chapter describes common problems, their probable causes and remedies, and provides contact information for technical support.

Solving Typical Problems

Some problems can be solved by simply resetting the transmitter. You can reset the transmitter by disconnecting the power or issuing the **RESET** command using the service port.

If resetting does not help, and if the problem is related to transmitter software or settings, you can restore the factory configuration of the transmitter by issuing the **FRESTORE** command. If you are unable to solve your problem with the transmitter, contact Vaisala technical support. See section Technical Support on page 60.

Table 11 Troubleshooting Table

Problem	Possible Causes and Solutions
Transmitter outputs stars "****" on serial line instead of measurement data	Possible causes: damaged sensor, incorrect supply voltage, and unsuitable measurement environment. Power cycle or reset the transmitter, and see if the problem continues. Check the active errors using the **ERRS** command. Check the power supply.
Unable to access transmitter on the RS-485 line.	Possible causes: Incorrect wiring, unknown serial settings, transmitter in POLL mode with unknown address. Check wiring. Try connecting as instructed in section Unknown Serial Settings on page 59. Issue the **??** command to make the transmitter respond in POLL mode.
Analog output seems to be stuck, the measurement is not changing.	Possible causes: Sensor diagnostics in progress (autocal or purge), malfunction error active. Check the active errors using the **ERRS** command. Wait for the diagnostics to complete.

Error Messages

The transmitter has error codes that can be displayed on the serial line using the **ERRS** command. See section Show Currently Active Errors on page 38.

Table 12 Error Messages

Error Message	Possible Cause and Solution
T MEAS error	MPS1 sensor damaged or missing. Contact a Vaisala Service Center.
F meas error	
Voltage error	Supply voltage out of range. Check and correct.
Voltage too low error	
Voltage too low for mA output	
Voltage is too low for V output	
Program flash check sum error	Internal transmitter error. If the error remains after a reset and restoring the factory settings, contact a Vaisala Service Center.
Parameter flash check sum error	
INFOA check sum error	
SCOEFS check sum error	
CURRENT check sum error	

Unknown Serial Settings

If you are not sure what the current serial settings of your transmitter are, follow the steps below to connect to the transmitter. This procedure assumes you have the USB service cable available.

For more information on the USB service cable and the PuTTY terminal application, see section Serial Communication on page 33.

1. Connect the USB service cable to your PC, but do not connect it to the transmitter yet.
2. Start a terminal application and open a terminal session using the default serial settings of 19200 8 N 1.
3. Plug the USB service cable into the transmitter, and immediately send the hash character # to the serial line:

   ```
   #
   ```
4. The normal startup of the transmitter is now interrupted, and the transmitter is available for commands with the default serial settings.
5. You can now check the transmitter's information by issuing the **?** command:

   ```
   ?
   ```

   The transmitter's currently stored serial settings are visible on the line marked **Baud P D S**.

Technical Support

For technical questions, contact the Vaisala technical support by e-mail at helpdesk@vaisala.com. Provide at least the following supporting information:

- Name and model of the product in question
- Serial number of the product
- Name and location of the installation site
- Name and contact information of a technically competent person who can provide further information on the problem.

Product Returns

If the product must be returned for service, see www.vaisala.com/returns.

It is important to protect the product from damage during the return shipment:

- Put the yellow transport protection cap on the sensor head, if available.
- Pack the product in the original product package.
- If the original package is not available, wrap at least 2 cm of protective material around each individual product, for instance, bubble wrap or plastic foam.

For contact information of Vaisala Service Centers, see www.vaisala.com/services/servicecenters.

CHAPTER 8

TECHNICAL DATA

This chapter provides the technical data of the DPT146.

Specifications

Table 13 Measured Parameters

Parameter	Measured Range
Dewpoint	-60 ... +30 °C (-76 ... +86 °F)
Pressure, absolute	1 ... 12 bar (14.5 ... 174 psi)
Temperature (RS-485 only)	-40 ... +80 °C (-40 ... +176 °F)

Table 14 Calculated Parameters

Parameter	Measured Range
ppm moisture, by volume	1 ... 40 000 ppm
Dewpoint, converted to atmospheric pressure	-75 … +30 °C (-103 ... +86 °F)

Table 15 Performance

Property	Description / Value
Dewpoint accuracy	±2 °C (±3.6 °F), see Figure 24 on page 62
Pressure accuracy at 23 °C (73.4 °F)	±0.04 %FS
Pressure temperature dependence	±0.01 bar/10 °C (18 °F)
Temperature accuracy 0 ... +40 °C (+32 ... +104 °F) -40 ... +80 °C (-40 ... +176 °F)	 ±0.5 °C (± 0.9 °F) ±1 °C (± 1.8 °F)
ppm accuracy (7 bar)	±(14 ppm + 12 % of reading)
Sensor response time Pressure response time Dewpoint response time 63% [90%] at 20°C and 1 bar -50 -> -10 °C Tdf -10 -> -50 °C Tdf	 < 1 s 5 s [10 s] 10 s [2.5 min]

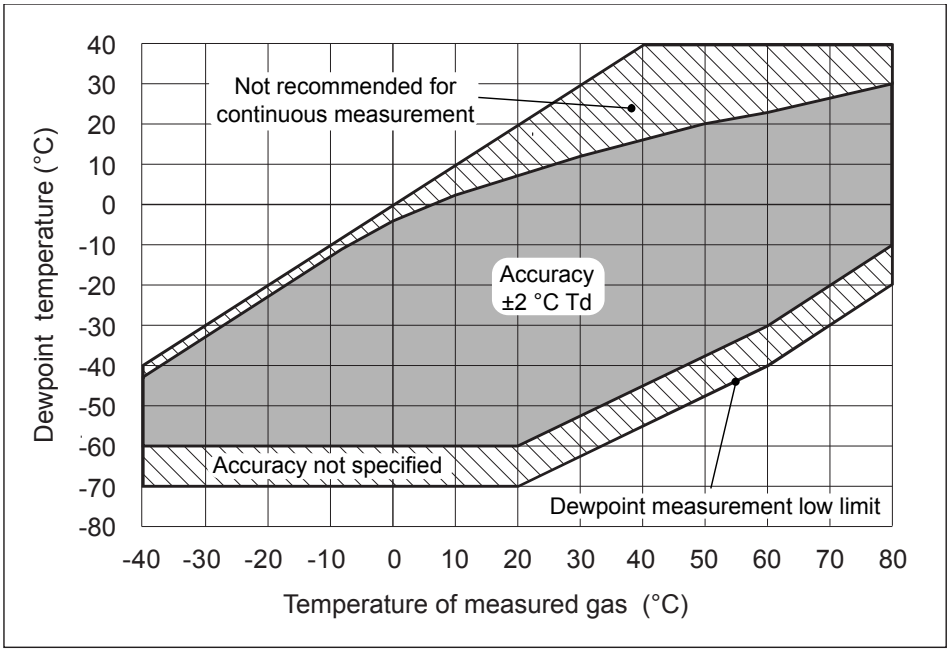

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Figure 24 DPT146 Dewpoint Measurement Accuracy

Table 16 Operating Environment

Property	Description / Value
Operating temperature of electronics	-40 … +60 °C (-40 ... +140 °F)
Pressure	0 … 50 bar (0…725 psi)
Relative humidity	0 ... 100 %
Measured gases	Air/non-corrosive gases
Sample flow rate	No effect on measurement accuracy

Table 17 Outputs

Property	Description / Value
Analog outputs (2 channels) current output voltage output	 0 … 20 mA, 4 … 20 mA 0 … 5V, 0 …10V
Accuracy of analog outputs	± 0.01 V / ± 0.01 mA
Digital output	RS-485, non-isolated, Vaisala protocol
Connector	4-pin M8

Table 18 General

Property	Description / Value
Sensor	Vaisala MPS1 multiparameter sensor
Operating voltage with current output with voltage output and when used in cold temperatures (-40 ... -20 °C (-40 ... -4 °F)) with RS-485	 21 ... 28 VDC 20 ... 28 VDC 15 ... 28 VDC
Supply current during normal measurement during self-diagnostics	 20 mA + load current 300 mA + load current
External load for current output voltage output	 max. 500 Ω min. 10 kΩ
Housing material	AISI316L
Housing classification	IP65 (NEMA4)
Sensor protection	Mesh filter AISI303, grade 18 µm
Storage temperature range transmitter only shipment package	 -40 … +80 °C (-40 ... +176 °F) -20 … +80 °C (-4 ... +176 °F)
Mechanical connection	ISO G1/2” NPT 1/2" UNF 3/4"-16
Recommended calibration interval	2 years
Weight (with ISO G1/2”)	190 g (6.70 oz)
Electromagnetic compatibility	Complies with EMC standard EN61326-1, Electrical equipment for measurement, control and laboratory use - EMC requirements; Industrial environment

Spare Parts and Accessories

Table 19 DPT146 Spare Parts and Accessories

Description	Order Code
Connection cable for MI70 Indicator / DM70 Dewpoint Meter	219980
USB connection cable	219690
Mesh Filter 18um Stainless Steel	220957SP
Sealing ring set, 3 pcs for ISO1/2" thread	221525SP
Sealing ring set, 3 pcs for UNF 3/4" - 16 thread	232912
Protection plug for connector	218675SP
Loop-powered external display	226476
ISO 1/2" plug	218773
NPT 1/2" plug	222507
Basic sample cell	DMT242SC
Sample cell with Swagelok 1/4" male connectors	DMT242SC2
Sample cell with quick connector and leak screw	DSC74
Two-pressure sampling cell	DSC74B
Two-pressure sampling cell with coil	DSC74C
Separate cooling/venting coil for sampling cells	DMCOIL
Flange	DM240FA
0.32m (1 feet) shielded cable, M8 threaded connector	HMP50Z032
3 m (9.8 ft) shielded output cable M8, threaded connector	HMP50Z300SP
5 m (16.4 ft) shielded output cable M8, threaded connector	HMP50Z500SP
10 m (32.8 ft) shielded output cable M8, threaded connector	HMP50Z1000SP

Dimensions in mm

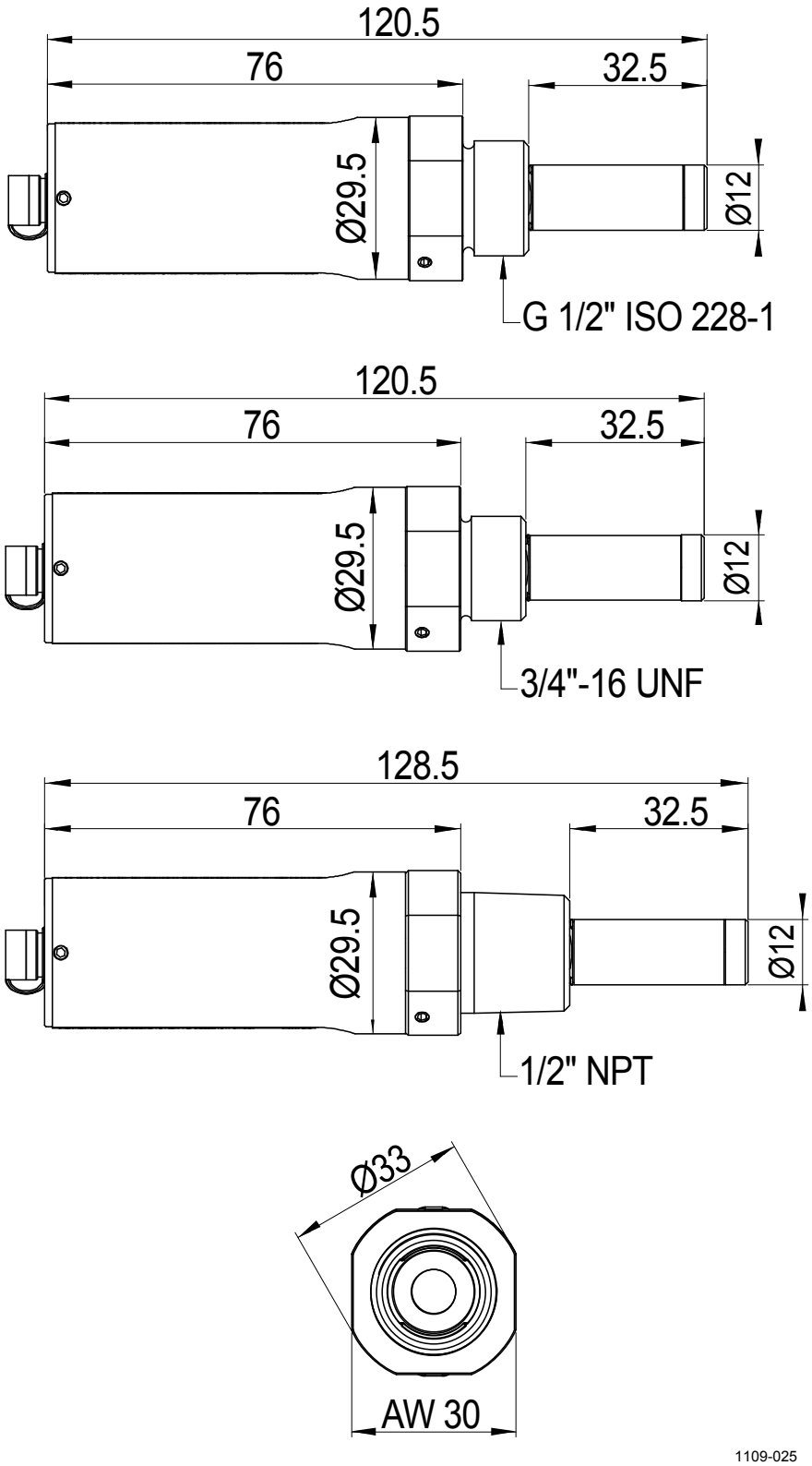


Figure 25 DPT146 Dimensions

APPENDIX A

MODBUS REFERENCE

This appendix describes the Modbus protocol implementation of the DPT146 transmitters.

Default Communication Settings

Table 20 below shows the default communication settings when Modbus is enabled at the factory.

Table 20 Default Communication Settings

Setting	Default Value	Configuration mode command for changing the value*
Bit rate	19200	SERI
Number of data bits	8	
Parity	E	
Number of stop bits	1	
Device address	240	ADDR
Response delay	0	SDELAY
Communication mode	MODBUS	SMODE

* See Table 6 on page 36.

NOTE You can also change device address with Modbus itself (register 1537).

Supported Modbus Functions

Table 21 Supported Function Codes

Function Code (decimal)	Function Code (hexadecimal)	Function Name (as defined by the specification)	Notes
3	03	Read Holding Registers	See Table 22 on page 67 for available registers.
16	10	Write Multiple Registers	See Table 22 on page 67 for writable registers.
43 14	2B 0E	Read Device Identification	See Table 23 on page 68 for available device identification objects.

NOTE After power-up, wait for five seconds before sending Modbus requests.

Modbus Register Map

Table 22 Modbus Register Map

Logical Address (decimal)	PDU Address (hexadecimal)	Register Description		Data Format	Register Type	Notes
5	00 04	T (measured)	LSW	32-bit float	read-only	°C
6	00 05		MSW			
7	00 06	$T_{d/f}$ (measured)	LSW	32-bit float	read-only	°C
8	00 07		MSW			
11	00 0A	$T_{d/f}$ (atm) (measured)	LSW	32-bit float	read-only	°C
12	00 0B		MSW			
21	00 14	H_2O (measured)	LSW	32-bit float	read-only	ppm_v
22	00 15		MSW			
45	00 2C	P (measured)	LSW	32-bit float	read-only	bara
46	00 2D		MSW			
513	02 00	Fault status		16-bit boolean	read-only	1 = no errors
514	02 01	Online status		16-bit boolean	read-only	1 = online data available
516	02 03	Error code	LSW	32-bit bit field	read-only	0 = no errors
517	02 04		MSW			
1283	05 02	Automatic purge on/off*		16-bit boolean	read/write	1= automatic purge on
1284	05 03	Start-up purge on/off*		16-bit boolean	read/write	1 = start-up purge on
1285	05 04	Purge in progress*		16-bit boolean	read/write	1 = purge in progress, write 1 for manual start
1537	06 00	Address		16-bit integer	read/write	1…255 (1 … 247 allowed in Modbus)

* Device specifications are valid only if purge functions are kept enabled. Do not modify registers 1283, 1284, and 1285. Regular purge is needed to guarantee accurate measurements. Modify only if instructed to by Vaisala.

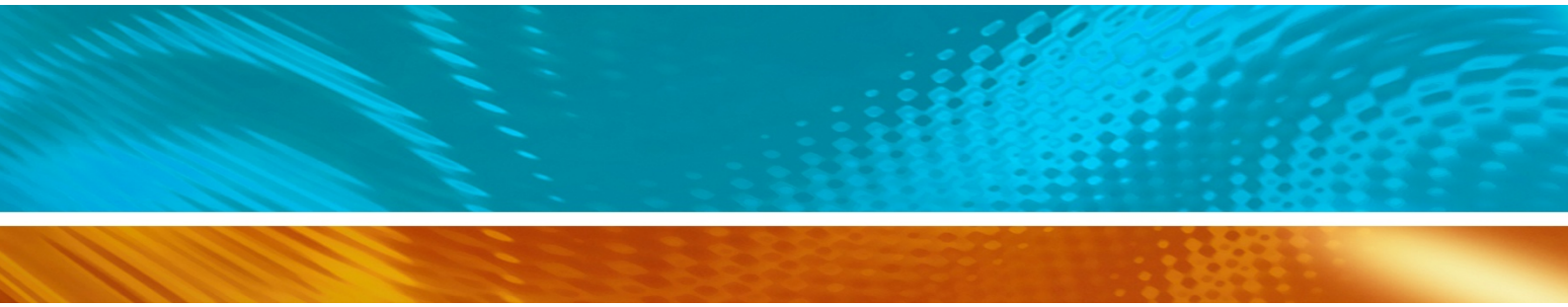
PDU address	Actual address bytes used in a Mdbus Protocol data unit
LSW	Least significant word (bits 15 … 0)
MSW	Most significant word (bits 31 … 16)
16-bit integer	Numeric value in range 0 … 65535
16-bit boolean	Numeric value, 0 or 1
32-bit bit field	32 individual values, each 0 or 1
32-bit float	Floating point; IEEE 754 format
read-only	Register value cannot be changed with Modbus functions
read/write	Register value can be changed with Modbus functions

Table 23 Device Identification Objects

Object Id (decimal)	Object Id (hexadecimal)	Object Name (as defined by the specification)	Example
0	00	VendorName	Vaisala
1	01	ProductCode	DPT146
2	02	MajorMinorVersion	1.3.27
3	03	VendorUrl	http://www.vaisala.com
4	04	ProductName	Vaisala Multiparameter Transmitter DPT146 for Compressed Air
128	80	SerialNumber*	D0710040
129	81	CalibrationDate*	2009-08-07
130	82	CalibrationText*	Vaisala/HEL

* Vaisala-specific device information object

NOTE Both stream access and individual access to the device identification objects are supported.



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